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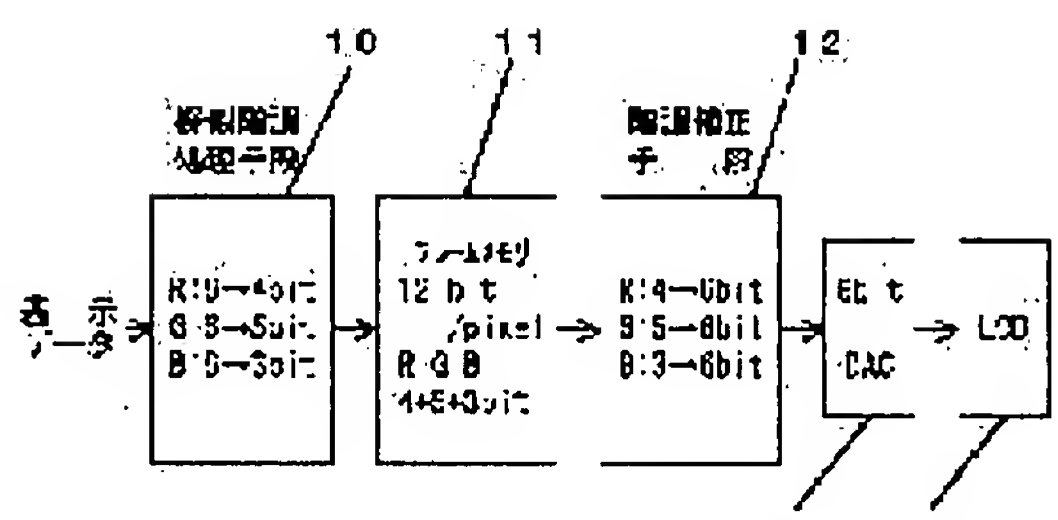
(54) DISPLAY DEVISE AND DISPLAY METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a display devise which has a high display quality level by using a small memory capacity.

SOLUTION: The display device is provided with an LCD 14, a pseudo-tone processing means 10 which receives display data and color-reduces each RGB component of incoming display data by using pseudo-tone processing, a frame memory 11 which stores the color-reduced display data, and a driving means 13 which drives the display device by using data derived from the display data stored in the frame memory. Color reduction is performed so that the tone number of each RGB component after color reduction is G component > R component > B component. The color reduction is



unequally performed in a manner which reflects contributions of each RGB component to brightness.

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CLAIMS

[Claim(s)]
[Claim 1] It is the display which inputs an indicative data as a display device, is equipped with the false gradation processing means which carries out subtractive color of RGB each component of this indicative data using false gradation processing, the frame memory which memorizes the indicative data by which subtractive color was carried out, and the driving means which drive said display device using the data of the indicative-data origin which said frame memory memorizes, and is characterized by to carry out the subtractive color of said false gradation processing means so that it may become the number of gradation reflecting the brightness contribution of RGB each component.
[Claim 2] A display device and the false gradation processing means which inputs an indicative data and carries out subtractive color of RGB each component of this indicative data using false gradation processing, It has the frame memory which memorizes the indicative data by which subtractive color was carried out, and the driving means which drives said display device using the data of the indicative-data origin which said frame memory memorizes. Said false gradation processing means is a display characterized by carrying out subtractive color so that the number of gradation of RGB each component after subtractive color may serve as a G component >R component >B component.
[Claim 3] The display according to claim 1 or 2 with which the number of gradation of G component is characterized by being 20 or less times after subtractive color exceeding the twice of the number of gradation of B component.
[Claim 4] The display according to claim 1 or 2 with which the number of gradation after subtractive color is characterized by being R component:G component:B component =2:4:1.
[Claim 5] The display according to claim 1 or 2 with which the number of gradation after subtractive color is characterized by being R component =16, G component =32, and B component =8.
[Claim 6] The display characterized by to have a display device, the false gradation processing means which inputs an indicative data and carries out subtractive color of RGB each component of this indicative data using false gradation processing, the frame memory which memorizes the indicative data by which subtractive color was carried out, a gradation amendment means to form into many bits the indicative data after the subtractive color which said frame memory memorizes, and the driving means which drives said display device using the indicative data formed into many bits.
[Claim 7] Said display device is a display given in six from claim 1 characterized by being LCD.
[Claim 8] The method of presentation characterized by to carry out subtractive color including the step which inputs an indicative data and carries out subtractive color of RGB each component of this indicative data using false gradation processing, the step which memorizes the indicative data by which subtractive color was carried out to a frame memory, and the step which drives a display device using the data of the indicative-data origin which said frame memory memorizes so that the number of gradation of RGB each component after subtractive color may serve as a G component >R component >B component.
[Claim 9] The method of presentation characterized by carrying out subtractive color so that it may become the number of gradation reflecting the brightness contribution of RGB each component

including the step which inputs an indicative data and carries out subtractive color of RGB each component of this indicative data using false gradation processing, the step which memorizes the indicative data by which subtractive color was carried out to a frame memory, and the step which drives a display device using the data of the indicative-data origin which said frame memory memorizes.
[Claim 10] The method of presentation according to claim 8 or 9 with which the number of gradation of G component is characterized by being 20 or less times after subtractive color exceeding the twice of the number of gradation of B component.
[Claim 11] The method of presentation according to claim 8 or 9 with which the number of gradation after subtractive color is characterized by being R component:G component:B component =2:4:1.
[Claim 12] The method of presentation according to claim 8 or 9 with which the number of gradation after subtractive color is characterized by being R component =16, G component =32, and B component =8.
[Claim 13] The method of presentation characterized by having the step which inputs an indicative data and carries out subtractive color of RGB each component of this indicative data using false gradation processing, the step which memorizes the indicative data by which subtractive color was carried out to a frame memory, the step which forms into many bits the indicative data after the subtractive color which a frame memory memorizes, and the step which drives a display device using the indicative data formed into many bits.
[Claim 14] A display device is the method of presentation given in 13 from claim 8 characterized by being LCD.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention carries out subtractive color of the multi-tone indicative data using a systematic dither method, an error diffusion method, etc., and a frame memory is made to memorize it, and it relates to the display which displays, and its approach.
[0002]
[Description of the Prior Art] Conventionally, subtractive color of the multi-tone indicative data is carried out using a systematic dither method, an error diffusion method, etc., and the approach of displaying with the display equipped with LCD with little gradation expression number of bits etc. is learned.
[0003] Originally, since the multi-tone expression was difficult as engine performance of a display device own one, such as LCD, this approach has been performed.
[0004] However, the case where it is rather carried out by meaning low-power-izing and cost reduction of equipment by reduction of display memory by improvement in the own gradation expression engine performance of a device in recent years is increasing.
[0005] There is the following reference about this kind of technique. First, the example which uses a systematic dither method is indicated by JP,9-50262,A. Moreover, the example which uses an error diffusion method is indicated by JP,6-138858,A.
[0006] And in these official reports, subtractive color of the indicative data of many bits (for example, RGB each component is 8 bits or 6 etc. bits) is carried out to 12 bits (4096 colors). Hereafter, although the example of explanation which carries out subtractive color of the indicative data of many bits to 12 bits (4096 colors) is taken up for convenience, this invention can be applied also when carrying out other subtractive color, unless it deviates from the meaning.
[0007]
[Problem(s) to be Solved by the Invention] Now, in these official reports, when carrying out subtractive color to 12 bits (4096 colors), 4 bits was distributed to RGB each component of each, respectively. Moreover, according to a 8-bit color coordinate system, it is referred to as R:G:B=3:3:2 (bit), or there is also an example set to R:G:B=5:6:5 (bit) by the 16-bit color coordinate system. Anyway, when it is not based on the thought that what is necessary is just to assign almost equally and cannot assign equally completely about RGB, it is only extent that reduces at most 1 bit or is increased (8 bits) (16 bits).
[0008] However, although the detailed reason was mentioned later, such distribution had brought a result on which there are too few G components and runs short of display grace, and has too many B components and amount of information is wasted, when having deviated from human being's vision property and saying the conclusion.
[0009] Since there were too few G components, more specifically, it was easy to generate a feeling of irregularity, a false profile, etc. between contiguity pixels. Moreover, since there were too many B components, the required amount of memory increased beyond the need, and had invited waste of money and cost rise of power consumption. This point is the 1st trouble.

[0010] This invention sets it as the 1st purpose to offer the display with which a beautiful display result is obtained also for small amount of information, and its approach in view of the 1st trouble.
[0011] Next, the 2nd trouble about the 2nd purpose of this invention is explained using drawing 8 - drawing 11 . Drawing 8 is the block diagram of the conventional indicating equipment.
[0012] In drawing 8 , the false gradation processing means 1 inputs an indicative data (in this example, although it is 6 bits of RGB each, 8 bits of RGB are sufficient each), and it carries out subtractive color to 4 bits each of RGB, and a total of 12 bits (4096 colors) by false gradation processing. Here, a systematic dither method or an error diffusion method is sufficient as false gradation processing of the false gradation processing means 1.
[0013] A frame memory 2 memorizes the data after the subtractive color which the false gradation processing means 1 outputs. Here, since it carries out subtractive color each to 4 bits of RGB, a frame memory 2 has the capacity memorized 12 bits per pixel.
[0014] A driving means 3 drives LCD4 based on the data of a frame memory 2. Here, as a display device, although LCD4 is used, CRT and a plasma display can also be used.
[0015] And it is data by which subtractive color was carried out, and expressed each as the conventional technique by 4 bits of RGB based on what was memorized by the frame memory 2.
[0016] In recent years, by advance of a technique, even if it is LCD, there are some which can be displayed by 6 bits (64 gradation), for example. And when the reflection factor property of LCD which indicates by 64 gradation is illustrated, it is as drawing 9 .
[0017] Moreover, if the reflection factor property of LCD by 4 bits after subtractive color (16 gradation) is illustrated, it will become like drawing 10 .
[0018] Now, gradation changes smoothly and can prevent color crushing etc., so that spacing of gradation data is actually close to "being visually equal", in order to drive LCD.
[0019] For this reason, in order to offset the reflection factor property of drawing 1 , in the driving means 3 of drawing 8 , it is possible to perform amendment by the property of drawing 11 .
[0020] However, with the conventional technique, even if it performs this amendment, if drawing 11 is seen, the gradation which can be displayed will become discrete so that clearly. Especially this point is remarkable by the halftone in which an irregular color tends to be conspicuous, and insufficient of the display grace of appearance. This point is the 2nd trouble.
[0021] This invention sets it as the 2nd purpose to offer the display which can maintain the display grace of appearance, and its approach, though subtractive color is carried out and the capacity of memory is saved in view of the 2nd trouble.
[0022]
[Means for Solving the Problem] With the display concerning this invention, for the 1st purpose A display device and the false gradation processing means which inputs an indicative data and carries out subtractive color of RGB each component of this indicative data using false gradation processing, It has the frame memory which memorizes the indicative data by which subtractive color was carried out, and the driving means which drives a display device using the data of the indicative-data origin which a frame memory memorizes, and subtractive color of the false gradation processing means is carried out so that it may become the number of gradation reflecting the brightness contribution of RGB each component.
[0023] Moreover, the number of gradation of RGB each component after subtractive color carries out subtractive color so that it may become a G component >R component >B component, and it constitutes a display.
[0024] With the display concerning this invention, for the 2nd purpose A display device and the false gradation processing means which inputs an indicative data and carries out subtractive color of RGB each component of this indicative data using false gradation processing, It has the frame memory which memorizes the indicative data by which subtractive color was carried out, a gradation amendment means to form into many bits the indicative data after the subtractive color which a frame memory memorizes, and the driving means which drives a display device using the indicative data formed into many bits, and a display is constituted.

[0025]
[Embodiment of the Invention] In an indicating equipment according to claim 1, an indicative data is inputted as a display device and it has the false gradation processing means which carries out subtractive color of RGB each component of this indicative data using false gradation processing, the frame memory which memorizes the indicative data by which subtractive color was carried out, and the driving means which drives a display device using the data of the indicative-data origin which a frame memory memorizes, and subtractive color of the false gradation processing means is carried out so that it may become the number of gradation reflecting the brightness contribution of RGB each component.
[0026] Moreover, the false gradation processing means which inputs an indicative data as a display device at an indicating equipment according to claim 2, and carries out subtractive color of RGB each component of this indicative data using false gradation processing, It has the frame memory which memorizes the indicative data by which subtractive color was carried out, and the driving means which drives a display device using the data of the indicative-data origin which a frame memory memorizes, and subtractive color of the false gradation processing means is carried out so that the number of gradation of RGB each component after subtractive color may serve as a G component >R component >B component.
[0027] By these configurations, according to human being's vision property, subtractive color of RGB each component can be carried out, and a beautiful display result is obtained for small amount of information.
[0028] In a display according to claim 3, the number of gradation of G component is 20 or less times after subtractive color exceeding the twice of the number of gradation of B component.
[0029] Moreover, in a display according to claim 4, the number of gradation after subtractive color is R component:G component:B component =2:4:1.
[0030] By these configurations, RGB each component after subtractive color can be made allocation reflecting brightness contribution.
[0031] In a display according to claim 5, the numbers of gradation after subtractive color are R component =16, G component =32, and B component =8.
[0032] RGB each component after subtractive color serves as a exponentiation of 2, and is easy to consist of hardware by this configuration.
[0033] In an indicating equipment according to claim 6, an indicative data is inputted as a display device and it has the false gradation processing means which carries out subtractive color of RGB each component of this indicative data using false gradation processing, the frame memory which memorizes the indicative data by which subtractive color was carried out, a gradation amendment means to form into many bits the indicative data after the subtractive color which a frame memory memorizes, and the driving means which drives a display device using the indicative data formed into many bits.
[0034] a series of processes which display after carrying out subtractive color, memorizing and forming many bits by this configuration -- it can carry out -- the same amount of memory as the conventional technique -- more -- texture -- a warm gradation display can be performed.
[0035] In an indicating equipment according to claim 7, a display device is LCD.
[0036] A cellular phone, a mobile computer, etc. are applicable to the electronic equipment of which portability is required with this configuration.
[0037] The gestalt of operation of this invention is explained referring to a drawing below. First, it precedes explaining a concrete configuration and the principle concerning bit allocation of this invention is explained.
[0038] First, visual spatial frequency characteristics are explained. Human being's vision sensibility has spatial frequency characteristics as shown in drawing 2 . Here, the axis of abscissa of drawing 2 is spatial frequency (c/deg), and an axis of ordinate is contrast sensitivity. moreover, the plot of a rhombus -- the data of brightness -- it is -- a square plot -- the plot of a chromaticity (red - green) and a trigonum -- a chromaticity (blue-yellow) -- then, it is.
[0039] In this graph, contrast sensitivity is the inverse number of a contrast threshold, and this contrast threshold is the minimum contrast from which brightness or a chromaticity changes spatially (average

luminance or an average chromaticity is fixed), which showed and asked human being for the stripes according to a sinusoidal pattern and which human being can perceive.
[0040] Moreover, spatial frequency converts the frequency of a sinusoidal pattern into human being's angle of visibility (deg).
[0041] If drawing 2 is seen, it understands that the lower right where contrast sensitivity fell shows the inclination of **, and contrast sensitivity is set to 1 and it becomes impossible to perceive stripes about both brightness and a chromaticity above fixed spatial frequency when spatial frequency becomes large. Moreover, the chromaticity generates this depression in small spatial frequency rather than brightness.
[0042] In the spatial frequency of ten (deg) extent, about a chromaticity, even if change (striped spacing : correctly [here] wavelength of a sinusoidal pattern) exists, human being will be deceived and does not look concrete uniformly. However, human being can detect change of brightness.
[0043] Next, human being's angle of visibility is explained. An angle of visibility is an angle which connects the view of an eye, and the both ends for observation and which two segments make, when human being looks at a certain candidate for observation. An angle of visibility will serve as a different value, if the width of face of the both ends for observation differs even when a view is fixed and the distance a view and for observation is fixed.
[0044] The angle of visibility is frequently used in the eye test, as shown in drawing 3 . an eye test -- a run DORUDO ring (it has nothing and one break for the "C" typeface) -- size -- the board arranged variously is shown to a test subject.
[0045] A test subject is one eye, from the location which only fixed distance separated from the board, the run DORUDO ring directed to the ** person is seen, and a break can be perceived, or the direction of the break replies to a question [say / either]. Incidentally, that eyesight is more than "1.0" means that this break can be perceived, when the break of this run DORUDO ring is 1 minute in an angle of visibility.
[0046] Based on the above premise next, the spatial frequency characteristics of the angle of visibility and vision in a display are explained.
[0047] A display has the pixel (pixel) by which in-every-direction a large number arrangement was carried out about both CRT and LCD. And an image is displayed with the value of the RGB component of each pixel.
[0048] Now, in an above-mentioned premise, if "striped spacing" is transposed to "the pitch between contiguity pixels", an above-mentioned premise is applicable to the check by looking in a display; as shown in drawing 4 .
[0049] Here, in order to specify an angle of visibility, observation distance (distance a view and for observation) must be defined. So, in this example, observation distance is assumed to be 30cm. Even if this observation distance assumes a commonsense value as a distance of the carried display and the eye of human being who looks at it and it applies other values, this invention can be carried out similarly.
[0050] If observation distance is assumed, the axis of abscissa "spatial frequency (c/deg)" of drawing 2 is convertible into "display resolution (PPI:pixel per inch)" of a display. If the result of the conversion is illustrated, it will be as drawing 5 .
[0051] When observation distance is about 30cm and display resolution is 100ppi extent from drawing 5 , although human being can perceive change between contiguity pixels about brightness, it turns out that the change will not be able to be perceived, but it will be deceived and is not uniformly visible about a chromaticity. In addition, at LCD, there are many things with the display resolution of 100ppi extent.
[0052] It is useful to the technique which the above knowledge makes it hard to be conspicuous [in the phenomenon of degrading the image quality of appearance, such as a feeling of irregularity, a false profile, etc. between contiguity pixels,] in the display which performs subtractive color with false gradation.
[0053] That is, the solution for making it hard to be conspicuous in such a phenomenon is "assigning only the smaller number of gradation but aiming at saving of amount of information about a component with low brightness contribution, while brightness contribution's gives many numbers of gradation and

raises display grace by the high component about RGB each component."
[0054] Next, the brightness contribution of RGB each component and the partition ratio of the number of gradation by it are arranged about CRT and LCD typical as a display.
[0055] About CRT, it is ITU-R. According to BT.709, brightness transform coefficients are R= 0.213, G= 0.715, and B= 0.072, and when B component with the smallest brightness transform coefficient is set to "1", the ratio of brightness contribution is R:G:B=3.0:9.9:1.0.
[0056] Therefore, about CRT with such a property, it is desirable to proportion the partition ratio of the number of gradation in the ratio of brightness contribution, and to set it to R:G:B=3:10:1 theoretically.
[0057] Moreover, this invention persons calculated the following actual measurement about the reflective mold LCD. That is, according to this actual measurement, brightness transform coefficients are R= 0.255, G= 0.473, and B= 0.131, and when B component with the smallest brightness transform coefficient is set to "1", the ratio of brightness contribution is R:G:B=1.9:3.6:1.0.
[0058] Therefore, about the reflective mold LCD with such a property, it is desirable to proportion the partition ratio of the number of gradation in the ratio of brightness contribution, and to set it to R:G:B=2:4:1 or 2:3:1 theoretically.
[0059] Moreover, this invention persons calculated the following actual measurement about the transparency mold LCD. That is, according to this actual measurement, brightness transform coefficients are R= 0.259, G= 0.622, and B= 0.119, and when B component with the smallest brightness transform coefficient is set to "1", the ratio of brightness contribution is R:G:B=2.2:5.2:1.0.
[0060] Therefore, about the transparency mold LCD with such a property, it is desirable to proportion the partition ratio of the number of gradation in the ratio of brightness contribution, and to set it to R:G:B=2:5:1 theoretically.
[0061] As mentioned above, also in any of CRT and LCD, in RGB each component, R component continues and brightness contribution has B component smallest [brightness contribution has largest G component, next].
[0062] Moreover, the brightness contribution of G component is in the 10 times [3 times to] as much range as that of B component. Therefore, with this gestalt, the number of gradation of G component is carried out 3 or more times after subtractive color in the range of 10 or less times of the number of gradation of B component.
[0063] However, even if it makes the number of gradation of G component into the range of 20 or less times exceeding the twice of the number of gradation of B component, it does not interfere practically.
[0064] As far as this invention persons get to know having taken the upper limit of "20 times", it is because there is the following LCD.
[0065] In this LCD, the peak wavelength of each light emitting device which emits light in the RGB three primary colors is lambdaR=630nm, lambdaG=530nm, and lambdaB=470nm.
[0066] The CIE-xy chromaticity-coordinate value of RGB each primary color is about R. (x y) = (0. 707957 0.292043)
G (x y) = (0. 154716 0.805833)
B (x y) = (0. 124142 0.057814)
[0067] And the ratio of the brightness contribution of RGB each light emitting device of this LCD is R:G:B=5:14:1.
[0068] Now, in case it constitutes from hardware, as for each value of a ratio, it is desirable that it is the exponentiation of 2. When it is made the exponentiation of 2, there is little futility of hardware and it is because the scale of hardware can be made small.
[0069] If the above point is taken into consideration, as for the partition ratio of the number of gradation, being referred to as R:G:B=2:4:1 is desirable. For example, in order to perform 4096 color specification using a 12-bit color component, it is optimal to make bit allocation into R= 4 bits, G= 5 bits, and B= triplet.
[0070] Above, above explanation of the principle of this invention is finished, next the concrete configuration of the display in this gestalt is explained using drawing 1 , drawing 6 , and drawing 7 . Drawing 1 is the block diagram of the indicating equipment in the gestalt of 1 operation of this

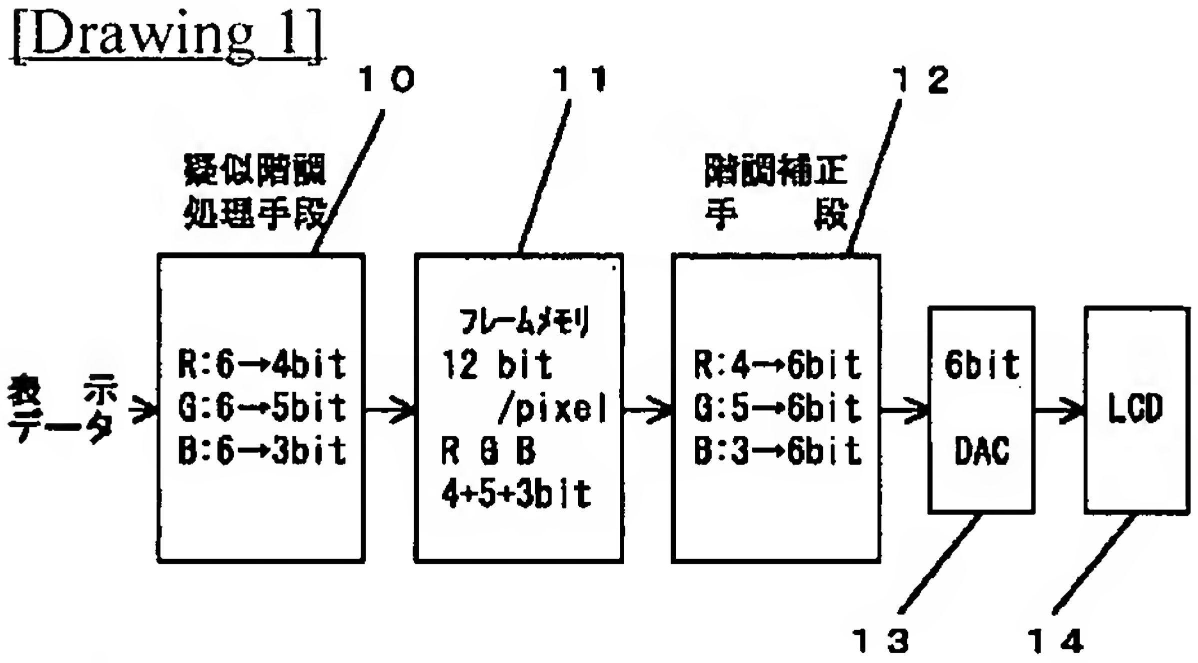
invention.
[0071] In drawing 1 , the false gradation processing means 10 inputs an indicative data (in this example, although it is 6 bits of RGB each, 8 bits of RGB are sufficient each), and it carries out subtractive color to a total of 12 bits (4096 colors) by false gradation processing. However, according to the principle mentioned above, the false gradation processing means 10 carries out subtractive color of the R component to 4 bits, and G component is made into 5 bits and it makes subtractive color of the B component to a triplet, respectively.
[0072] Here, a systematic dither method or an error diffusion method is sufficient as false gradation processing of the false gradation processing means 10.
[0073] A frame memory 11 memorizes the data after the subtractive color which the false gradation processing means 1 outputs. In this example, a frame memory 11 has the capacity memorized 12 bits per pixel like drawing 8 which shows the conventional technique. Therefore, power consumption and cost are almost the same as the conventional technique.
[0074] however, the principle mentioned above -- following -- a frame memory 11 -- per pixel and R component -- 4 bits and G component -- 5 bits and B component -- a triplet -- it memorizes, respectively.
[0075] Now, after amending 12 bit data of a frame memory 11 to 18 bit data, he is trying to output to a driving means 13 with this gestalt, with a gradation amendment means 12 by which unlike the conventional technique did not output to a driving means 13 as it is, but are the latter part of a frame memory 11 and 12 bit data of a frame memory 11 were prepared in the location of the preceding paragraph of a driving means 13 as shown in drawing 1 .
[0076] Specifically, this driving means 13 is the drive circuit carried on the LCD driver LSI and the LCD substrate, a DA converter circuit for CRT, a drive circuit for plasma displays, etc.
[0077] This gradation amendment means 12 amends each 4 bits R component, 5-bit G component, and B component of a triplet to 6-bit data, respectively. Specifically, each component which was shown in drawing 6 and by which subtractive color was carried out using the 1-dimensional bit translation table is formed into many bits. Here, although many bits are formed to 6 bits (64 gradation), many bits can also be formed to other bit values.
[0078] Although the point which forms 4-bit R component into many bits to 6 bits is explained hereafter, since numeric values only differ and G component (5->6 bits) and B component (3->6 bits) can be processed similarly, explanation is omitted.
[0079] Now, a driving means 13 will see from each component by which was memorized by the frame memory 11 and subtractive color was carried out, and will input the data formed into many bits. For this reason, a driving means 13 can be replaced with amendment (what offsets a reflection factor property) of the conventional technique by the property of drawing 11 , and amendment (what offsets a reflection factor property) by the property of drawing 7 can be performed.
[0080] If drawing 11 is compared with drawing 7 , with this gestalt, the gradation which can be displayed becomes 4 times and is more precise so that clearly. In the halftone in which an irregular color tends [especially] to be conspicuous, gradation can be changed smoothly and display grace can be improved sharply.
[0081] Therefore, when LCD14 of drawing 1 is what indicates by 64 gradation, the engine performance can fully be demonstrated. In addition, in drawing 1 , as a display device, although LCD (a reflective mold, a transparency mold, and transflective type any are sufficient) was used, it is also possible to use CRT and a plasma display.
[0082] Here, please observe drawing 1 anew. In drawing 1 , the amount of memory of a frame memory 11 is the same (12 bits per pixel) with drawing 8 which shows the conventional technique. However, the data by which subtractive color was carried out with the false gradation processing means 10 are memorized by the frame memory 11, and the data with which subtractive color of the frame memory 11 was carried out are formed into many bits with the gradation amendment means 12, and are outputted to a driving means 13.
[0083] That is, a series of processes of "an amendment -> display of the subtractive color -> storage ->

many bit-ized -> driving means 13" are carried out. the amount of memory same by this as the conventional technique -- it is -- more -- texture -- a warm gradation display can be performed.
[0084] Of course, since RGB each component ratio at the time of carrying out subtractive color is doubled with human being's vision property and used as the G component >R component >B component according to the principle mentioned above, a high-definition legible display is realizable further here.
[0085] In addition, in drawing 1 , the false gradation processing means 10 and the gradation amendment means 12 may consist of any of software/hardware.
[0086] Moreover, in drawing 1 , the gradation amendment means 12 is also omissible. Although the data in a frame memory 11 will be outputted to a driving means 13 when omitting, it is good to add dummy data and to make it RGB each component become 6 bits about RGB each component like drawing 1 , when using the 6-bit driving means 13.
[0087] In this example, the data of this dummy serve as [component / R / component / 2 bits and / G] a triplet about 1 bit and B component.
[0088] Or although not illustrated, the driving means (4 bits of R components, 5 bits of G components, B component triplet) corresponding to the different number of bits can also be used about RGB each component.
[0089]
[Effect of the Invention] At claims 1, 2, 8, and 9, subtractive color doubled with human being's vision property is performed, and display grace can be improved in the small amount of memory.
[0090] In claims 3, 4, 10, and 11, RGB each component after subtractive color is made to allocation reflecting brightness contribution.
[0091] RGB each component after subtractive color serves as a exponentiation of 2, and hardware is easy to constitute it from claims 5 and 12.
[0092] after carrying out subtractive color, memorizing and forming many bits in claims 6 and 13, while controlling the amount of memory by displaying -- texture -- a warm gradation display can be performed.
[0093] In claims 7 and 14, it is easy to apply to the electronic equipment which needs portability.

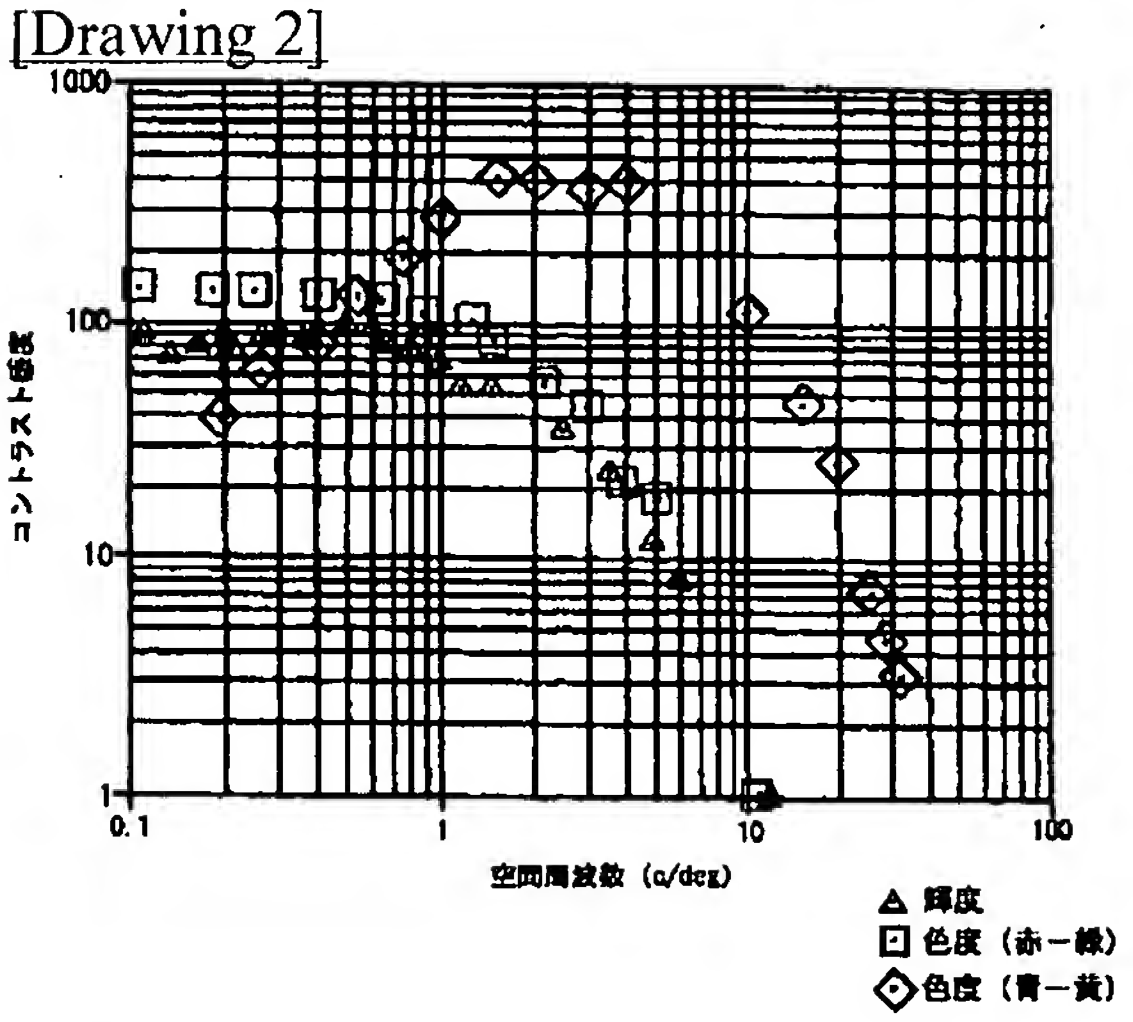
[Translation done.]

DRAWINGS

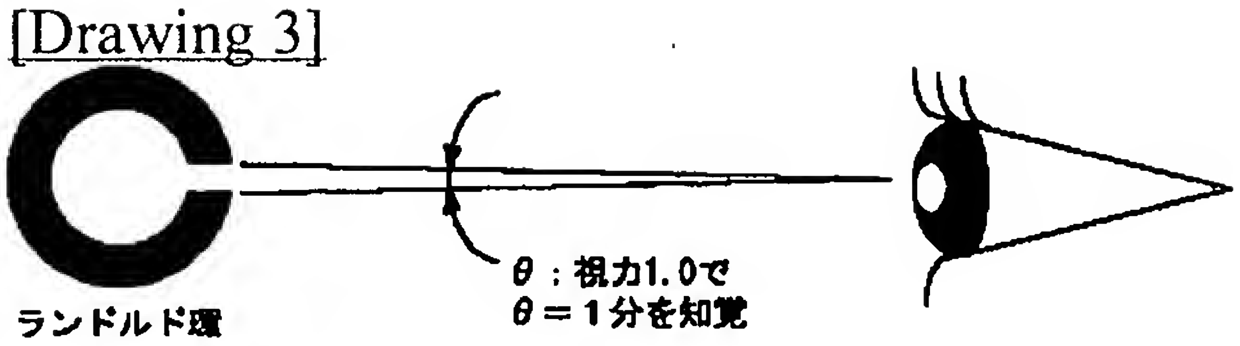
[Drawing 1]



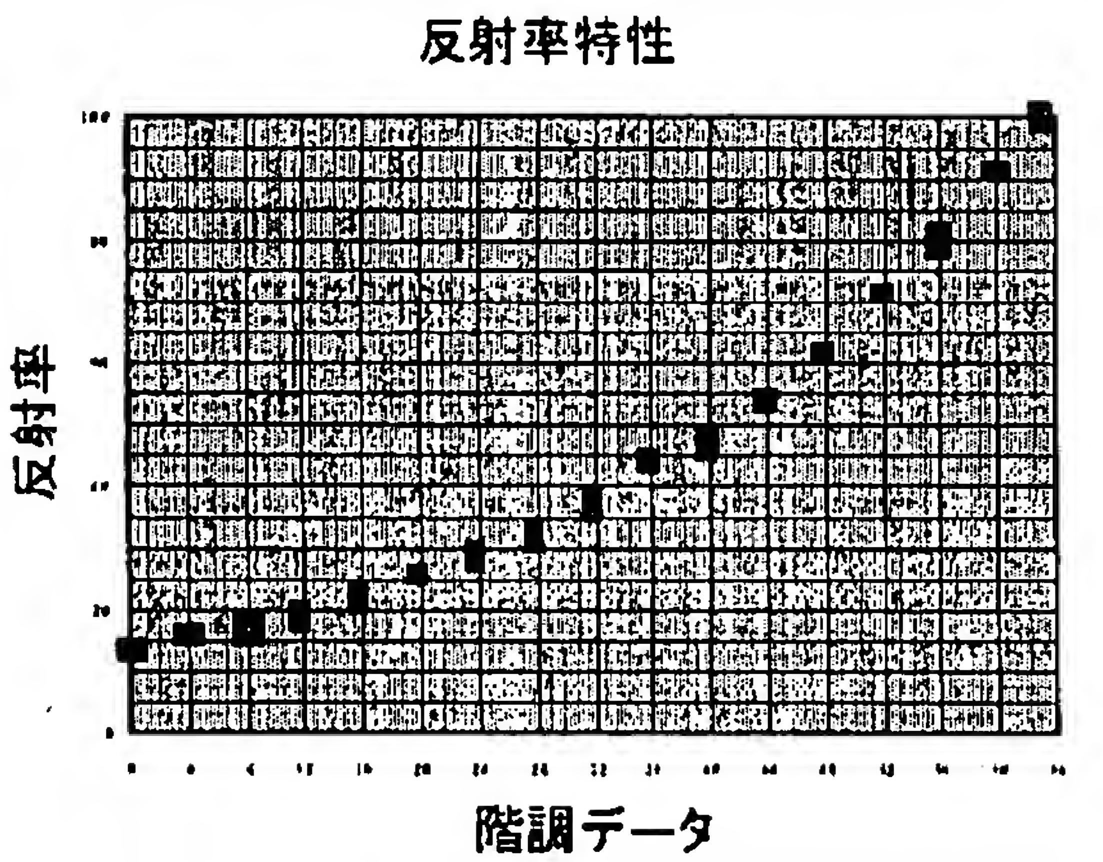
[Drawing 2]



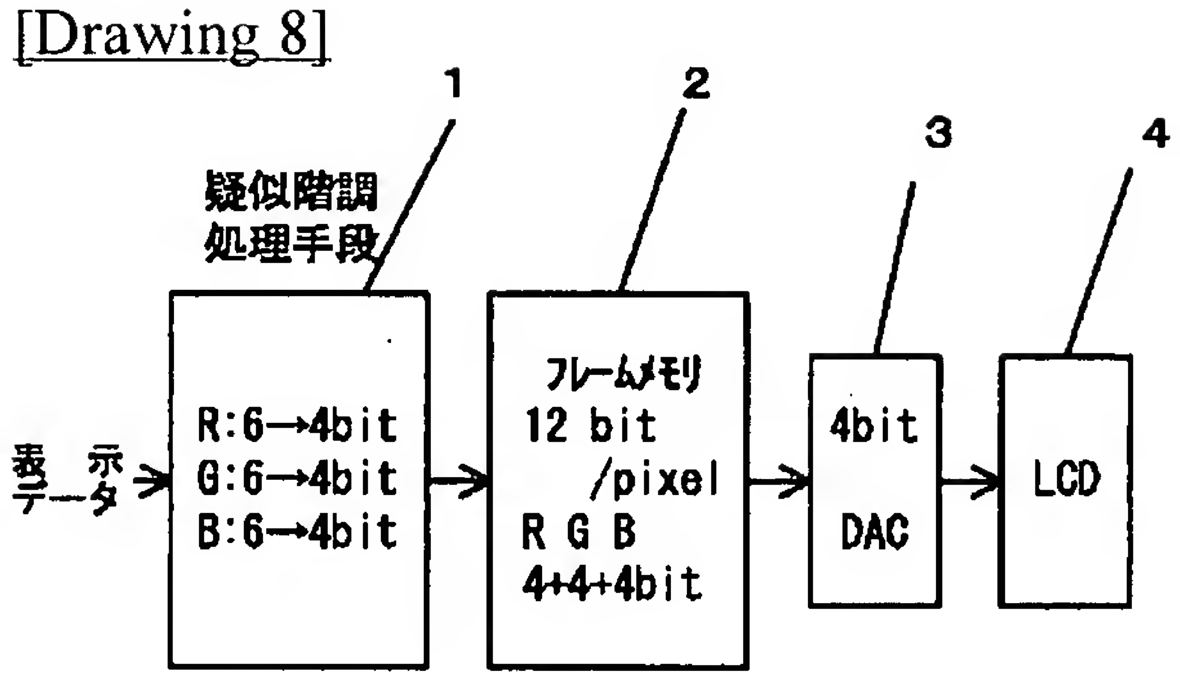
[Drawing 3]



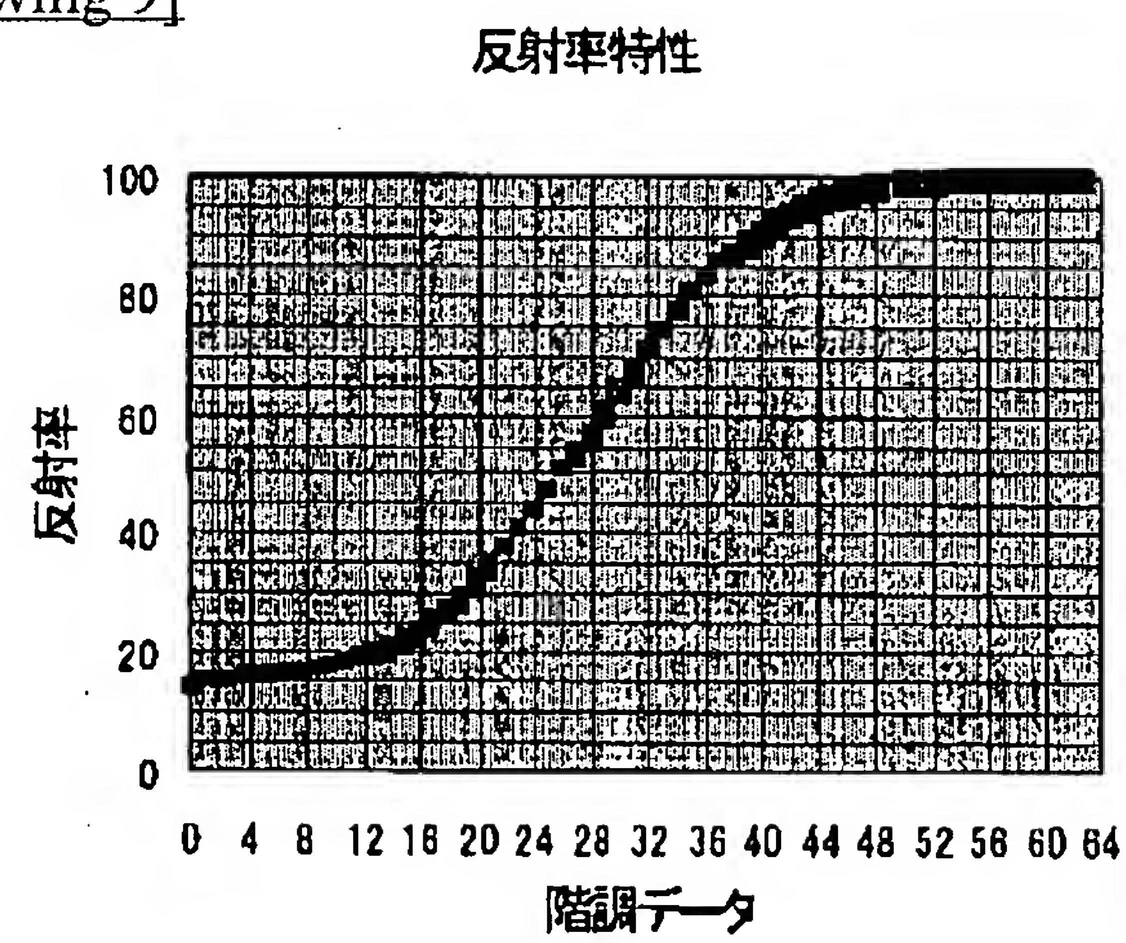
[Drawing 4]



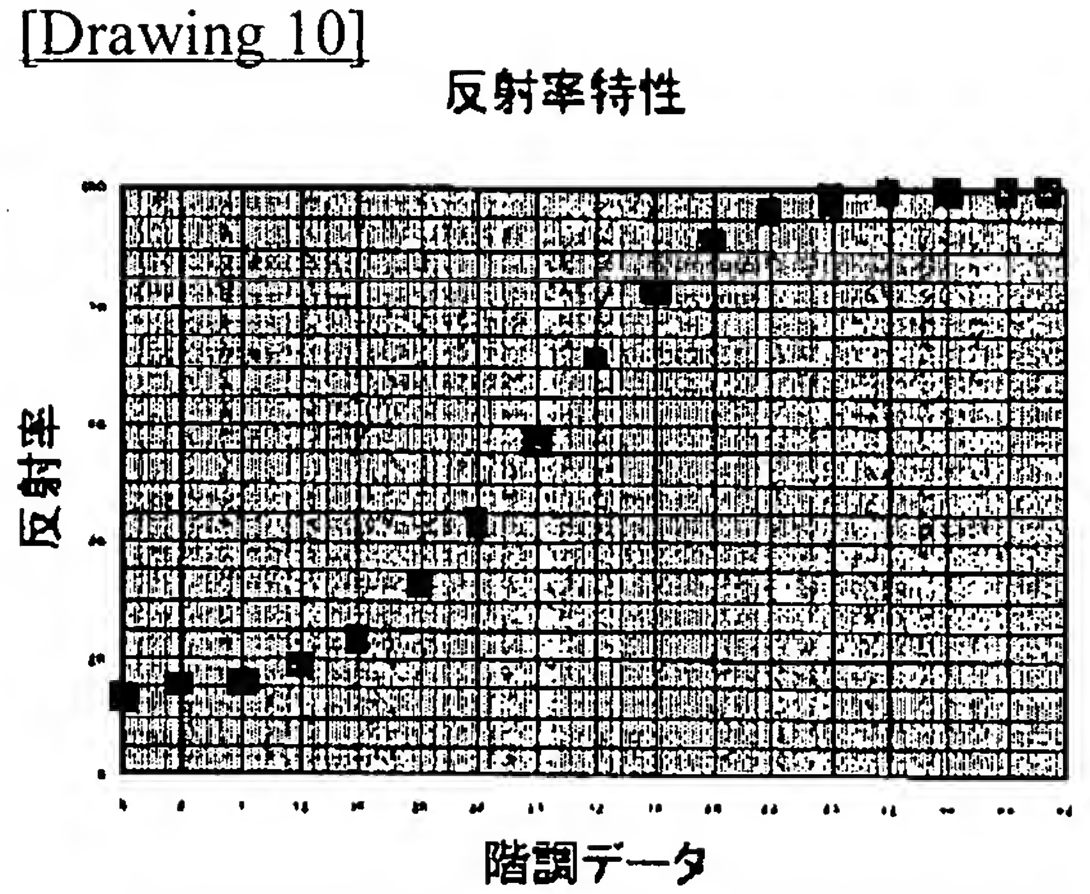
[Drawing 8]

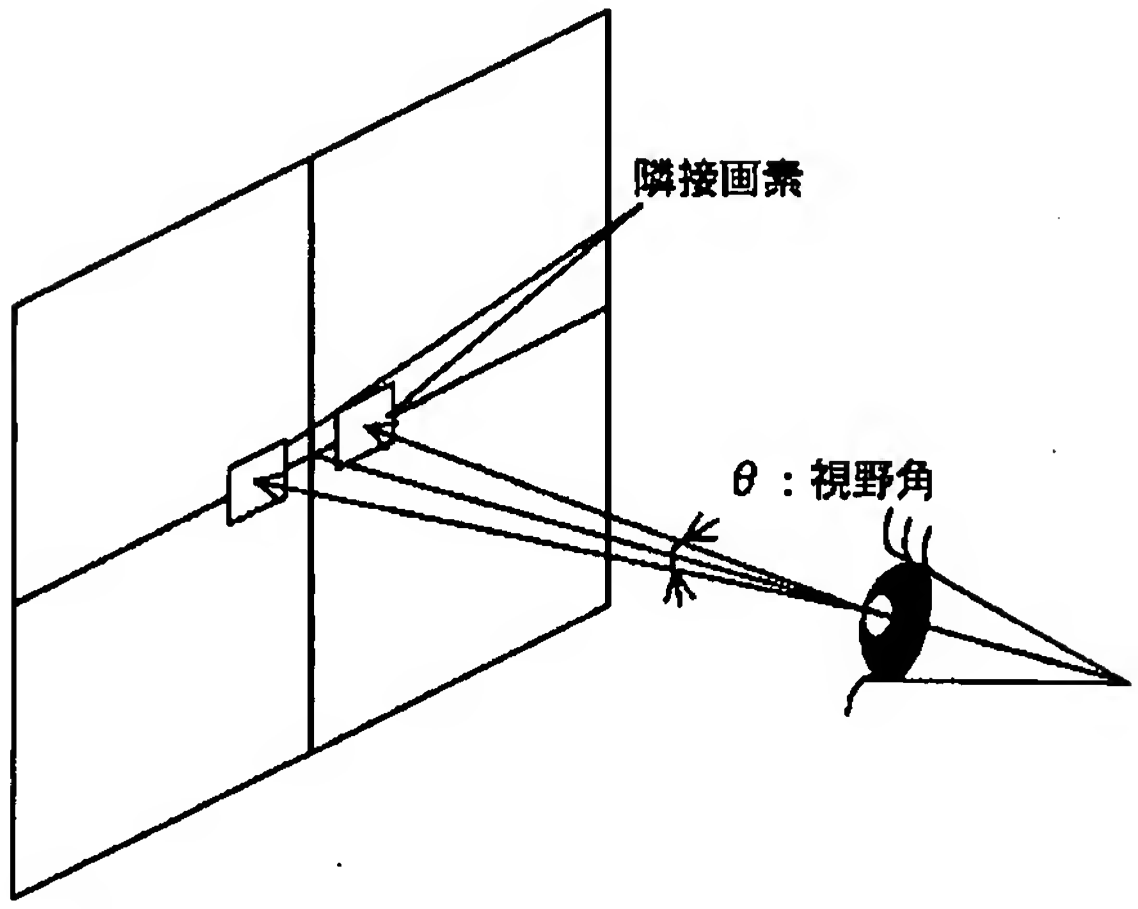


[Drawing 9]

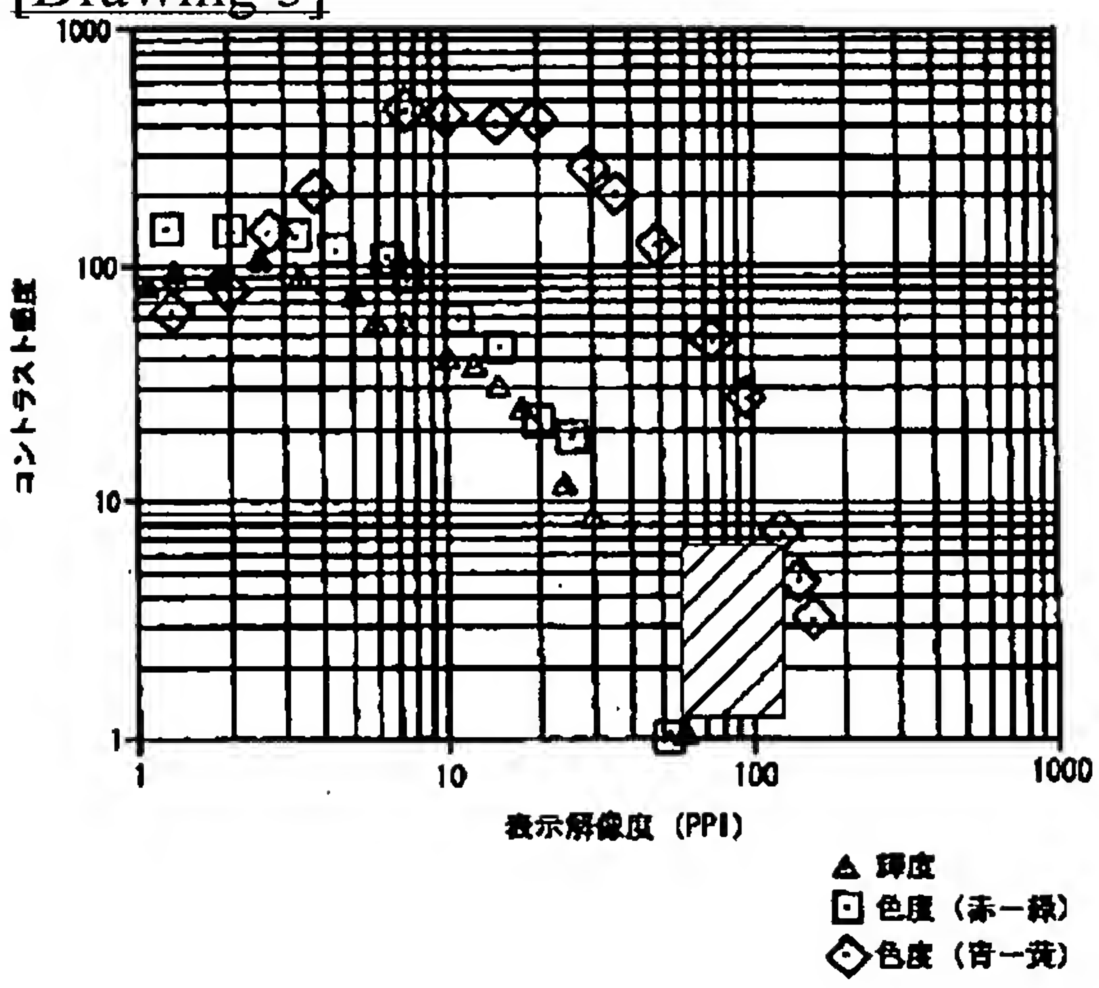


[Drawing 10]





[Drawing 5]



[Drawing 6]

3→6ビット変換テーブル

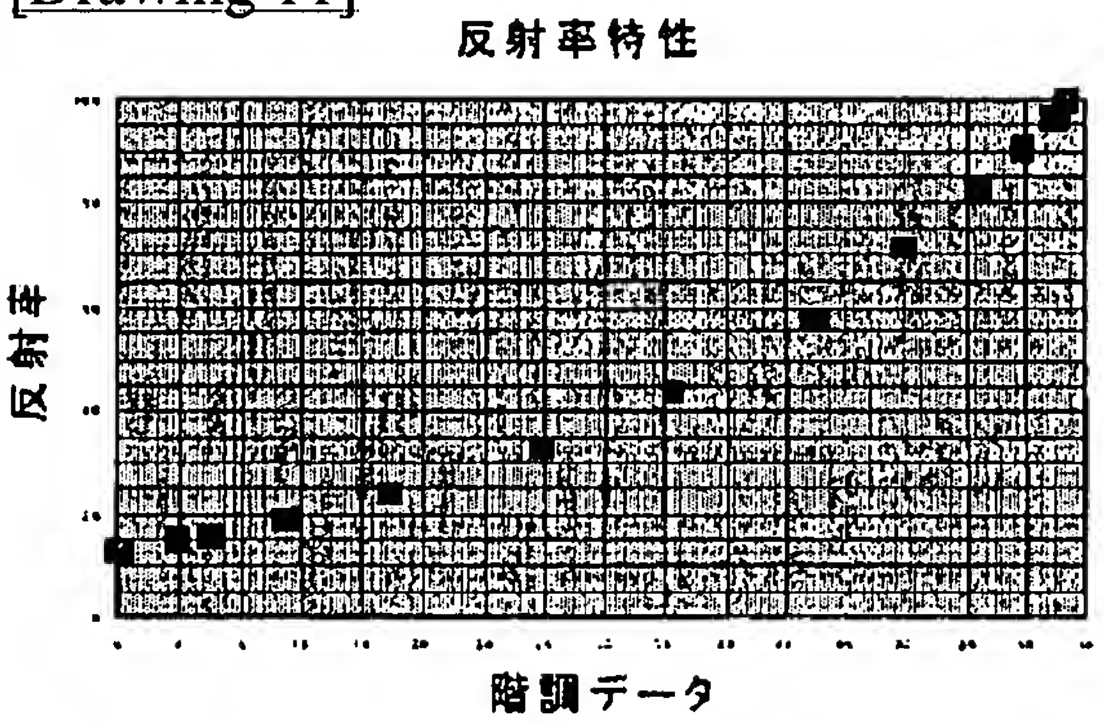
5→6ビット変換テーブル

4→6ビット変換テーブル

4ビット値	6ビット値
0	0
1	3
2	10
3	12
4	15
5	17
6	19
7	20
8	22
9	24
10	25
11	27
12	29
13	32
14	35
15	40
16	63

[Drawing 7]

[Drawing 11]



[Translation done.]